Introduction

EPA Public Drinking Water Stage 2 Rule Package

Stakeholder Meeting
September 26, 2006

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Housekeeping:

- Sign in
  - One sheet for the web site
  - One sheet for contact information
  - Print name and affiliation clearly
- Cell phones off
- Lunch is on your own
  - There is a cafeteria on this floor
  - Also there is a cafeteria in Building A on the First Floor
  - List of nearby restaurants is included in your file folder
- Please return from lunch on time
- In case of Emergency, meet in the Parking Garage

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Ground Rules

- Mutual respect
- No side conversations
  - Everyone wants to participate in the discussions
- All input is welcome
- Comments will be recorded on flip charts
- Issues that are outside the scope of this rulemaking will be place in "parking lot" for later discussion

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Goals of This Meeting

- Initiate stakeholder process for EPA Drinking Water Stage 2 Rule Package
- Discuss meeting dates for next two meetings
  - (October and November)
- Share information about rule making background, process, and scope
- Get input on two specific elements:
  - Chlorine dioxide (LT2) and
  - Public Notice (PNR) / Consumer Confidence Report (CCR)
- Share your input on these elements

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Roles and Responsibilities

- Facilitator
  - Impartially assist group in conducting discussions.
  - Ensure participation of all group members.
- Scribe
  - Capture all comments impartially and clearly.
- Stakeholders
  - Provide input / direction to TCEQ. Learn from others / teach others. Represent constituency. Respect and recognize other constituency perspectives.
- TCEQ Program Staff
  - Listen to stakeholders. Provide input when asked.
- TCEQ Management
  - Ensure stakeholder meetings adhere to policy.

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Mission

- TCEQ Mission:
  - "…protect our state's human and natural resources consistent with sustainable economic development."

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SCHEDULE

- Morning
  - Provide background and basis
    - Federal rulemaking
    - State rulemaking
- Afternoon
  - Comments on chlorine dioxide analytical method
  - Comments on Public Notice and CCR
  - Discuss dates for next meetings

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Overview and History

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BACKGROUND

- Outline:
  - Federal rulemaking
  - State rulemaking

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EPA Rule Making Process for Drinking Water

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1970: EPA was born

- All states (including Texas) had previously adopted various standards
  - Under their state health codes
  - Especially rules related to
    - Well and surface water treatment plant construction and design
    - Disinfection, microbial testing
    - Some common chemical standards (nitrate)
- Unlike pollution standards
  - Most states did not have them

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Safe Drinking Water Act (SDWA) ~1972

- Included State input through stakeholder process
- Created drinking water regulation at federal level:
  - 40 CFR 141: National Primary Drinking Water Regulations
  - Extended chemical and microbial standards nationwide
  - Maximum Contaminant Levels and Treatment Technique Requirements
    - For microbial and chemical constituents
- Created concept of "primary enforcement authority" (primacy)
  - 40 CFR 142: Special Primacy Requirements
  - Required state rule to be at least as stringent for primacy
  - Allowed states to retain existing rules related to design

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Current EPA Rule Making Process

- Federal Statute drives EPA rules
  - EPA is driven by SDWA and its amendments
  - General Congressional mandates to achieve public health protection goals
    - "Determine risk and occurrence and set health-based standards"
  - EPA must evaluate science, perform risk analysis, evaluate cost benefit

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Federal Regulatory Negotiation (Reg Neg) Process

- EPA uses the Reg Neg process for rulemaking
  - The Negotiated Rulemaking Act of 1996, Pub. Law 104-320
  - Formal process of involving stakeholders prior to making rule
  - FACA = Federal Advisory Committee Act
- EPA makes all drinking water rules using FACA–Reg Neg process

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Federal Regulatory Negotiation (Reg Neg) Process (cont.)

- Specific group (25 people) are group
  - Represent broadest scope of interests
  - ASDWA, AMWA, NRWA, AWWA, NAWC, State regulators, EPA Regions, etc.
  - Association reps must represent Associations' views
- Consensus must be achieved
  - Draft language is developed within process
  - Recommendations for EPA to provide guidance

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Elements of SDWA included roots of today's rules

- THM rule: Trihalomethane Rule (1979)
  - Established 0.10 mg/L Maximum Contaminant Level (MCL) for total trihalomethane (TTHM) for community systems over 10,000
- SWTR: Surface Water Treatment Rule
  - Established requirement to filter surface water (on federal basis)
  - Established Treatment Technique (TT) requirement: 1.0 NTU
    - For turbidity (NTU = Nephelometric turbidity unit)
  - Distribution disinfection of surface water

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Texas Rule Making Process for Drinking Water

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Texas History

- 1913: Used non-regulatory methods to encourage chlorination
  - Sanitary engineers, Public Health regulators
  - No federal rules except for interstate commerce
    - 1912: Federal "Common Cup" rule for trains
- 1937: First State Rules (only 7 pages long)
  - Texas State Department of Health Division of Sanitary Engineering
  - "Procedure for Submitting Plans Pertaining to Public Water Supplies - Water Purification Plants -Water Distribution Systems"
- 1949: Required disinfection of all distributed water

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Rulemaking process

- Rule changes are most commonly driven by federal or state legislation:
  - EPA Rule
    - State must be as stringent for primacy
  - Texas Legislative Statute
    - TCEQ must incorporate legislative direction into Texas Administrative Code
  - Petition
    - TCEQ must respond to specific change requests

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"Not More Stringent"

- New rules will not be proposed that are more stringent than federal rules.
- Intent to protect Texas from "over-regulation":
  - Consistent with TCEQ mission with respect to economic development
  - All rules are analyzed to determine fiscal impact to regulated community

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Planning Timeframe

- September 2006 – November 2006:
  - Stakeholder meetings – You are getting in at beginning.
- November 2006 – February 2007:
  - Staff incorporates federal language into proposed rule, taking into consideration stakeholder comments.
- February 2007 – April 2007:
  - Staff develops fiscal analysis and preamble.
- Proposal~Late June 2007
  - 30-Day Comment period.
- August 2007 – October 2007:
  - Staff will respond to comments.
- Adoption~Mid-December 2007
- *Note – all dates subject to change*

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Not formal Reg Neg,
but stakeholder input is actively sought

- April 22, 1996: TCEQ Resolution Concerning Public Participation
  - "... the Commission believes that public input is essential..."
  - "... the Commission shall strengthen ... opportunities for public participation..."

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Drinking Water Advisory Work Group (DWAWG)

- Long history of drinking water stakeholder participation
  - Ongoing participation of stakeholders with public drinking water program
  - Started in 1992 - met quarterly since then
  - Representation from broad spectrum of Texas drinking water community

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Universe of Texas Drinking Water Stakeholders

- Customers of public water systems (PWSs)
  - 94% C, NTNC, 23 million, everyone: TNCs
- PWSs: Producers of drinking water
  - 6,700 PWSs
  - Municipalities, utilities, districts, investor owned utilities
  - Communities (4600), NTNCs (800), TNC (1200)
- PWS Operators 15,000
- Industries who sell to producers of drinking water
  - Engineering consultants, construction, labs, chemical vendors, equipment vendors
- Regulators and funding organizations
  - TCEQ, DSHS, TWDB (SRF), ORCA
- Environmental community

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Role of stakeholders

- Consider the impact of potential regulation on your constituencies
- Let TCEQ know those impacts
- Participate in 'good government'

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Long Term 2 Enhanced Surface Water Treatment Rule

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Contents

- LT2ESWTR Purpose
- SWTR Overview
- All About Cyrpto
- Costs and Benefits
- Rule Overview
- Source Water Monitoring
- Bin & Treatment Overview
- Toolbox Options
- Implement Option(s)
- Follow-up Monitoring
- Profiling and Benchmarking
- Other Issues

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Purposes of the LT2ESWTR

- Improve public health protection
  - Reduce illness caused by *Crypto* and other microorganisms
  - Tailor requirements based on:
    - Level of treatment
    - Source water quality
    - System size
  - Provide systems and states with flexibility
- Supplement and fill data gaps
  - Most systems will only need to monitor
- Balance disinfection with control of DBPs

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Surface Water Background

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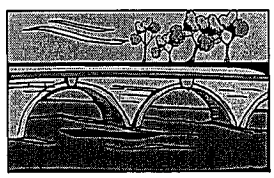
Surface Water

- Source for most large systems in U.S.
- Serves majority of people in U.S.
- Especially vulnerable to microbial contamination
- *Crypto*, *E. coli*, and *Giardia lamblia* present in most surface waters
- Series of regulations addresses heightened risk



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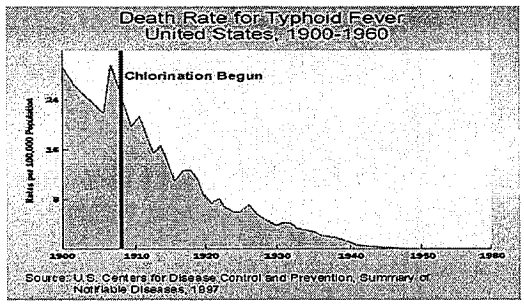
Disinfection & Filtration

Disinfection

- Essential part of water treatment
- Creates DBPs
- *Crypto* resists traditional disinfectants

Filtration

- Most surface water systems filter
- Key barrier against microbial contamination
- Physical process can remove *Crypto*
- Disinfection still necessary



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Filtration Avoidance Criteria

- Not Allowed in Texas

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Understanding "Log"

- For training, refers to percent of *Crypto* that is removed by treatment or other measures

Log	% removal / inactivation
0.5-log	68.4%
1-log	90%
2-log	99%
3-log	99.9%
4-log	99.99%
5-log	99.999%

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"Log" Removal Example 1

	System A	System B
Source Water	**100,000 *Crypto* oocysts**	**100 *Crypto* oocysts**
Crypto Reduction	2-log removal/ inactivation (99%)	2-log removal/ inactivation (99%)
Finished Water	1,000 *Crypto* oocysts	1 *Crypto* oocyst

Both systems provide the same level of *Crypto* removal/inactivation, but System B provides higher quality finished water

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"Log" Removal Example 2

	System A	System B
Source Water	100,000 ***Crypto*** oocysts	100 ***Crypto*** oocysts
Crypto Reduction	5-log removal/ inactivation (99.999%)	2-log removal/ inactivation (99%)
Finished Water	1 *Crypto* oocyst	1 *Crypto* oocyst

Both systems provide the same public health protection, but System A must work harder!

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"Log" Removal Example 3

	System A	System B
Source Water	1,000 ***Crypto*** oocysts	1,000 ***Crypto*** oocysts
Crypto Reduction	3-log removal/ inactivation (99.9%)	2-log removal/ inactivation (99%)
Finished Water	1 *Crypto* oocyst	10 *Crypto* oocysts

System A and B have the same source water *Crypto* level but System A provides a greater level of removal/inactivation, resulting in higher quality finished water!

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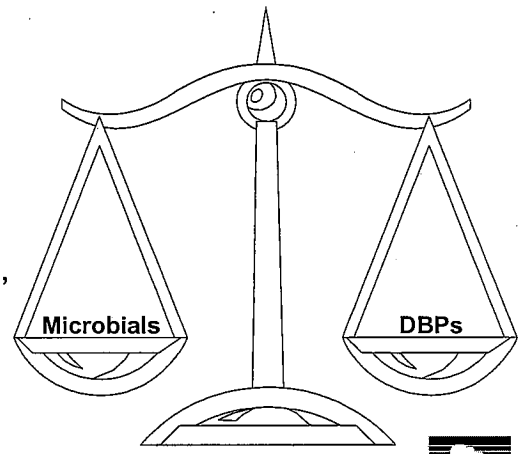
A Delicate Balance

- ✓ Risk: microbial contamination vs. DBP formation
- ✓ EPA's solution: control health risks from microbials, disinfectants, and DBPs
- ✓ Result: M-DBP suite of rules



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M-DBP History

- LT2ESWTR (2006)
  - Improves microbial protection
  - Builds on SWTR, IESWTR, & LT1ESWTR
  - Does not change any existing requirements from SWTR suite
- Stage 2 DBPR (2006)
  - Builds on Stage 1 DBPR
- Addressing multiple threats with multiple approaches

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SWTRs Summary

SWTR (1989)	• All SW and GUI systems • Reduce risks from *Giardia lamblia* & viruses
IESWTR (1998)	• SW and GUI systems serving ≥ 10,000 • Address *Crypto* with improved treatment
LT1ESWTR (2002)	Requirements similar to IESWTR applied to SW and GUI systems serving < 10,000
LT2ESWTR (2006)	• All SW and GUI systems • Target additional treatment at highest-risk systems

Questions?

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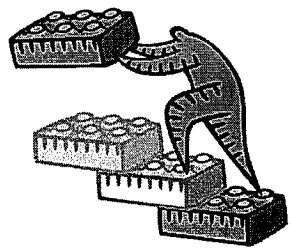
Review of SWTRs

- The LT2ESWTR builds on and complements previous SWTRs
- Offers flexibility to systems and states
- Focuses protection on the systems that need it most



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SWTRs Summary: All Systems

Ongoing Requirements

- Residual disinfectant continuously at entry point
  - ≥ 0.2 mg/L
  - Small system may take grab samples
- Distribution system residual measurements
  - Detectable in distribution system
  - Measure at same time & place as TCR
  - Never undetectable in >5% samples for 2 consecutive months
- Removal
  - *Crypto*: 2-log
- Removal and/or inactivation
  - *Giardia*: 3-log
  - Viruses: 4-log
- Monitor water parameters to calculate CT

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SWTRs Summary: ≥ 10,000

ONGOING	ADDITIONAL
■ Monitoring: ■ CFE every 4 hours ■ 95% ≤ 0.3 NTU ■ Max = 1 NTU ■ IFE continuously	■ Monthly for source water: ■ *Crypto* ■ *E. coli* ■ Turbidity ■ Monitor for 24 months ■ Possible additional removal and/or inactivation

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SWTRs Summary: < 10,000

ONGOING	ADDITIONAL
■ CFE every 4 hours ■ 95% ≤ 0.3 NTU ■ Max = 1 NTU ■ IFE continuously OR ■ CFE continuously if no more than 2 filters	■ Monthly for source water: ■ *Crypto* ■ *E. coli* ■ Turbidity ■ Monitor for 24 months ■ Possible additional removal and/or inactivation

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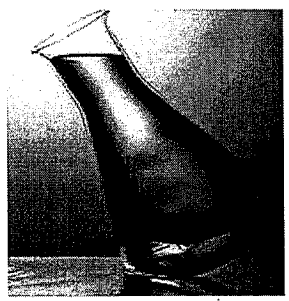
Cryptosporidium (Crypto)

- Protozoan parasite
- Common in surface water
- Resistant to traditional disinfectants
- Can pass through filters
- Causes cryptosporidiosis
- Filtration and alternative disinfectants can remove and/or inactivate



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What is Cryptosporidium?

- Protozoan parasite that lives and reproduces in one host
- Transmission
  - Contaminated food or water
  - Direct contact with feces
  - Direct or indirect contact with sick individuals
- 4-5 micron Oocysts
  - Can survive for months without host

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Crypto Health Effects

- Mild to severs diarrhea, dehydration, stomach cramps and slight fever
- Immunocompromized individuals can die from infection by cryptosporidium
- No known cure for cryptosporidiosis

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Crypto Efficacy

- Highly resistant to standard disinfectants like chlorine and chloramines
- Physical removal can work, but small size can allow for oocysts to pass through filters
- Crypto outbreaks have occurred in areas served by filtered surface water supplies
  - 1993 Milwaukee, 403,000 persons effected, 50 dead
- Alternative disinfectant show ability to inactive crypto (ozone, chlorine dioxide, UV)

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Benefits and Costs

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Economic analysis looked at a range of alternatives

Alternative	Mean Source Water Cypto (oocysts/L)	Additional Treatment requirements
Preferred Alternative	<0.075 ≥0.075 and <1.0 ≥1.0 and <3.0 ≥3.0	No additional Treatment 1 Log 2 Log 2.5 Log
Alternative A1		2.0 log required for all
Alternative A2	<0.03 ≥0.03 and <0.1 ≥0.1 and <1.0 ≥1.0	No additional Treatment 1 Log 2 Log 2.5 Log
Alternative A4	<0.1 ≥0.1 and <1.0 ≥1.0	No additional Treatment 0.5 Log 1.0 Log

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Benefits of LT2

- Benefit analysis based on reduction in the risk of endemic cryptosporidiosis
  - Reduce 89,375 to 1,459,126 illnesses annually
  - Reduce 20 to 312 deaths annually

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Costs of LT2

- Costs to PWSs needing to change treatment
  - Estimated number of plants
  - Estimated number of system
- Costs of reporting to all PWSs
- Costs to state governments

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Benefits of LT2, cont.

- Monetization of benefit
  - Value of statistical life (VSL)
    - $5.6 million (elsewhere $6.3 million)
  - Willingness to pay (to avoid non-fatal case)
    - Cost of illness measurement ($121,000) or
    - Willingness to pay measurement ($587,500)

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Costs of LT2

- 96.5 % of households will incur $0-12/yr.
- 3.5% of households will incur $12-120/yr.
- 0.01% of households will incur over $120/yr.

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Economic analysis: Cost and Benefit of Alternatives

Alternative	Annual Costs	Annual Benefits
Preferred Alternative	$ 133	$ 1,853
Alternative A1	$ 403	$ 1,895
Alternative A2	$ 163	$ 1,871
Alternative A4	$ 81	$ 1753

* One example of cost/benefit

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LT2 Overview

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LT2ESWTR Overview

- Source water monitoring
- Screening procedure for small systems
- Target treatment for highest-risk systems

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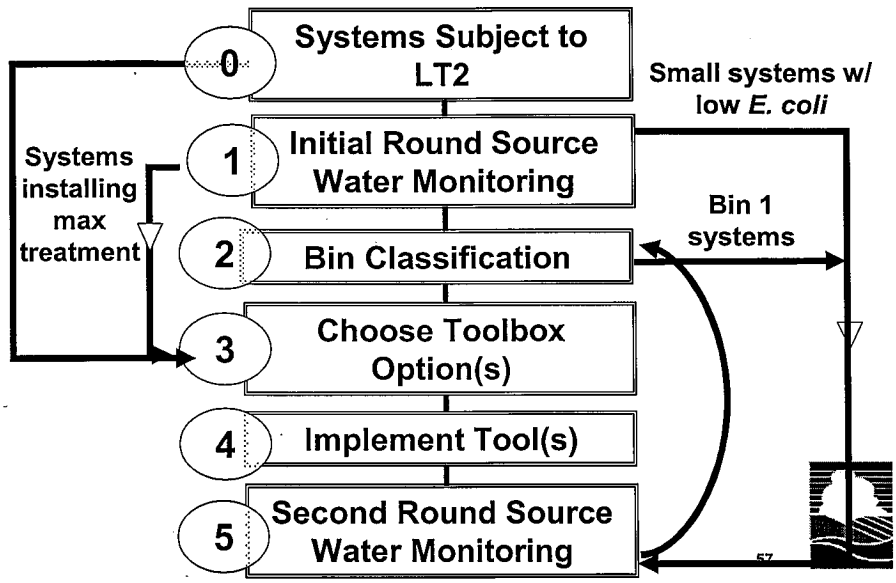
LT2ESWTR Process



Applicability

- Use surface water or GUI sources
- CWSs, NTNCWSs, TNCWSs
- Wholesale systems
- Compliance deadlines and options based on people served
  - Divided into four schedules
  - Wholesale systems with own source(s) comply based on population of largest system in their CDS
- Filtered and unfiltered systems

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Schedules

If you have a SW or GUI source and are this kind of system:	*You are on Schedule number:*
System serving 100,000 or more people OR a wholesale system in a CDS that contains a system serving ≥100,000	1
System serving 50,000 to 99,999 people OR a wholesale system in a CDS that contains a system serving 50,000 to 99,999	2
System serving 10,000 to 49,999 people OR a wholesale system in a CDS that contains a system serving 10,000 to 49,999	3
System serving fewer than 10,000 and not a wholesale system (not covered in today's training)	4

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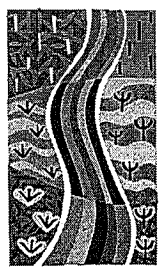
Combined Distribution Systems (CDSs)

- CDS requirements apply to wholesale system only
- Compliance date for wholesaler in CDS is based on population of largest system in CDS
- Largest system is not necessarily the wholesaler
- Not all requirements apply to purchased systems without a SW or GUI source



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Combined Distribution System (cont.)

- If a wholesale system is placed on the schedule of a larger system in its CDS
  - System must monitor on larger system's schedule
  - System must meet monitoring requirements based on population of larger system
  - System has same monitoring options as larger system

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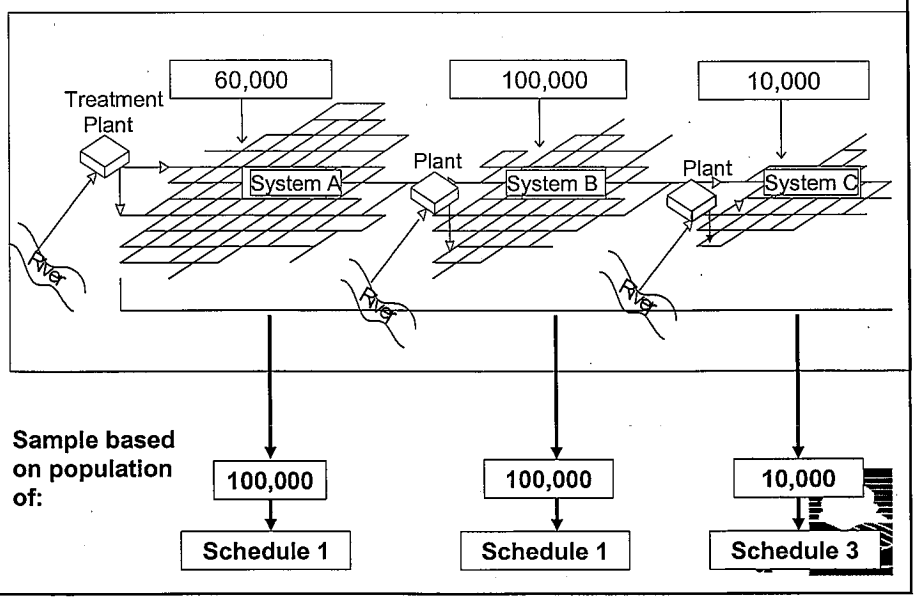
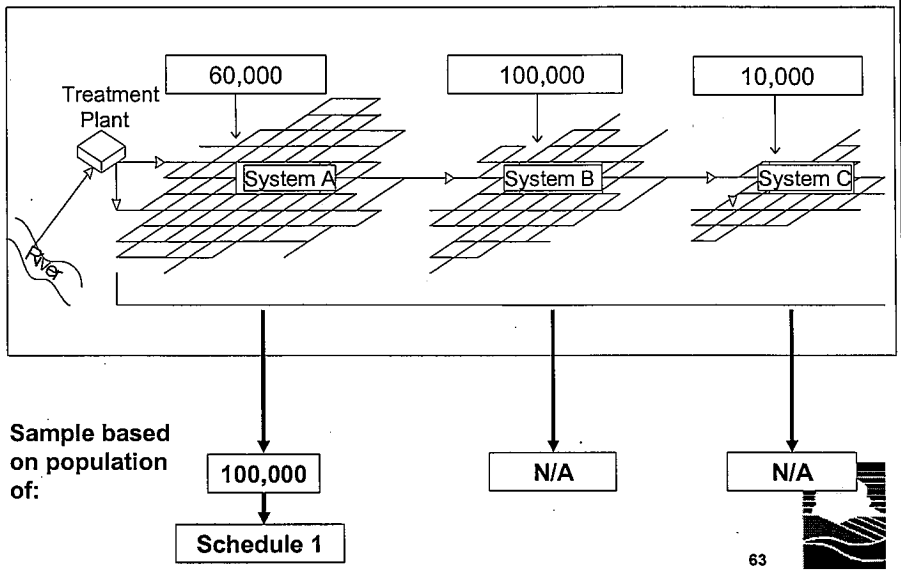
Combined Distribution Systems (cont.)



Combined Distribution Systems (cont.)



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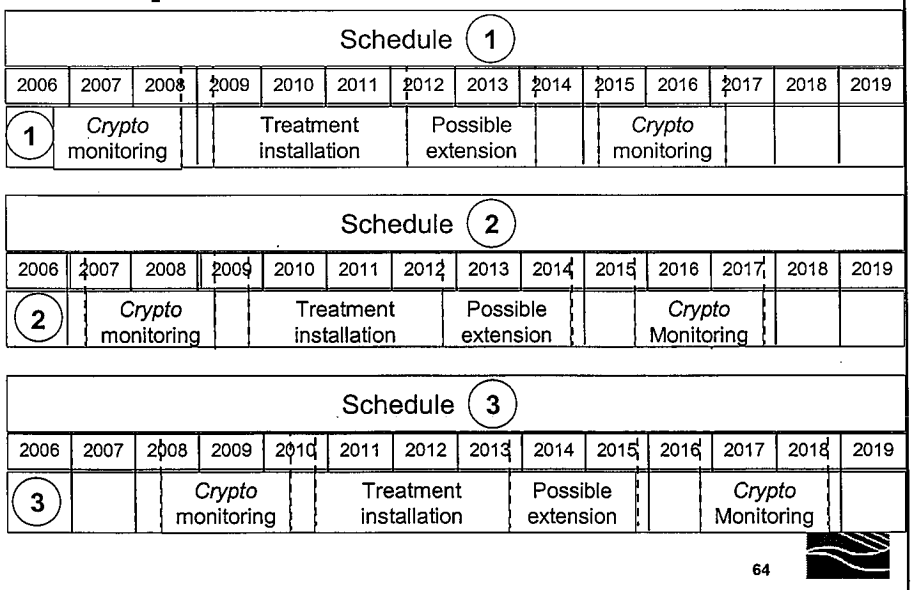
Implementation Timeline



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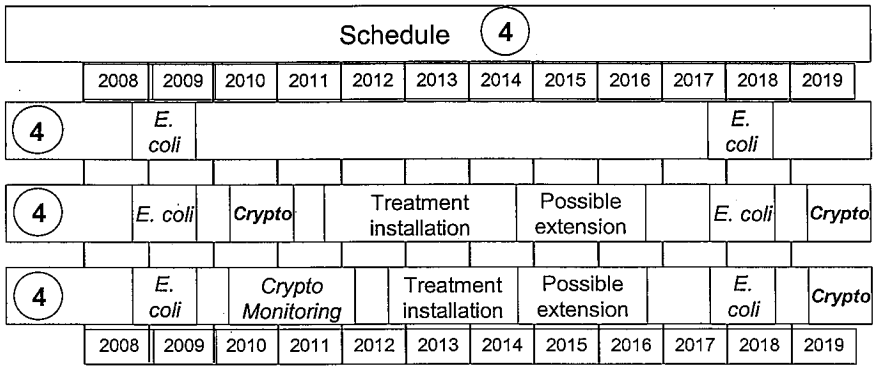
Implementation Timeline



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Schedule 4 Systems

- Earliest compliance deadline is October 2008
- Schedule 4 systems have flexibility in *Crypto* frequencies
  - 24 samples over 1 or 2 years
  - Can choose to monitor for *E. coli*
  - Only required to monitor for *Crypto* if *E. coli* triggers exceeded

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Bin Classification for Crypto Systems

Bin	Crypto level	Inactivate or Remove
Bin 1	Crypto < 0.075/L	No added
Bin 2	0.075 to 1.0 /L	1-log
Bin 3	1.0 to 3.0 /L	2-log
Bin 4	≥ 3.0 /L	2.5-log

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Bin Classification for E. Coli Systems

Bin	E. Coli. or Crypto level	Inactivation or removal
Bin 1	E. Coli < 10/100mL (lake) E. Coli < 50/100mL (flowing stream) Crypto ≤ 0.075/L	No added
Bin 2	0.075 to 1.0 /L	1-log
Bin 3	1.0 to 3.0 /L	2-log
Bin 4	> 3.0 /L	2.5-log

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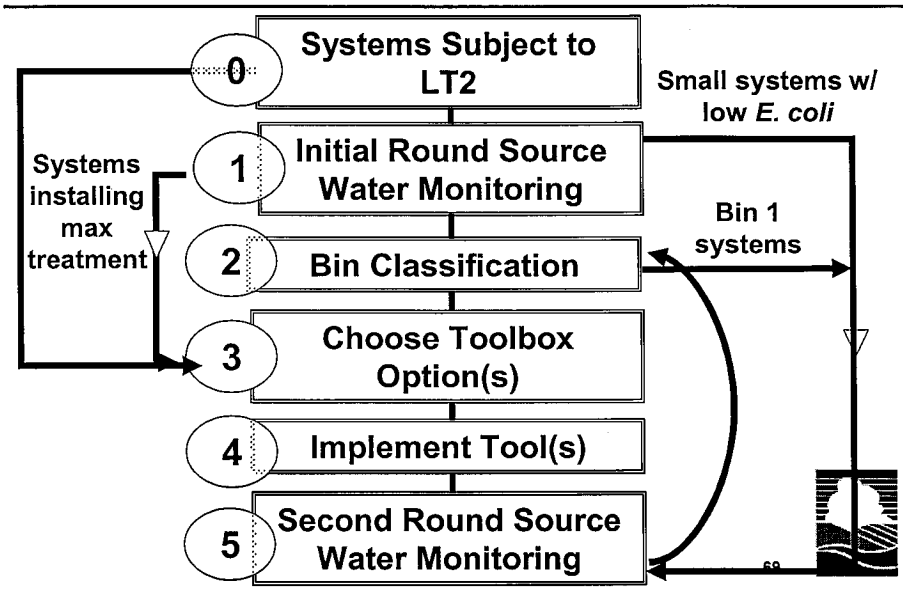
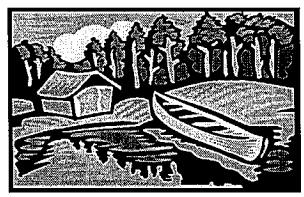
LT2ESWTR Process



1 Source Water Monitoring

- Requirements based on:
  - System size
  - Wholesale status
  - Source water
  - Filtration status
  - Operating calendar
- Initial round
  - Start date based on system size
  - For wholesale systems, based on largest system in CDS
- Grandfathering is permitted



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2 Bin & Treatment Overview

- PWSs are classified into one of four bins
  - Based on initial monitoring results
- May set additional requirements
  - Bin 1: no additional treatment
  - Bins 2, 3, 4: additional treatment or control processes

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3 Toolbox Options

- Source protection and management
  - Watershed control Program
  - Alternative Source/intake management
- Prefiltration
  - Presedimentation basin with Coagulation
  - Two-stage lime softening
  - Bank filtration
- Treatment performance
  - CFE performance
  - IFE performance
  - Demonstration of performance

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3 Toolbox Options (cont.)

- Additional filtration
  - Bag or Cartridge filtration (individual or in series)
  - Membrane
  - Second Stage Filtration
  - Slow Sand Filters
- Inactivation
  - Chlorine Dioxide
  - Ozone
  - UV

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Chlorine Dioxide Methods

- Lissamine Green B – **NEW**
  - Chlorine dioxide
- Horseradish Peroxidase – **NEW**
  - Chlorite
  - Not commercially available
- DPD/Glycine
  - Chlorine dioxide
  - DPB1 method but not currently allowed in TX
  - Interferences by high levels of chloramines in certain water
  - No accompanying chlorite method

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4 Implement Option(s)

- Install chosen treatment to meet bin requirements:
  - Schedule 1 – April 1, 2012
  - Schedule 2 – October 1, 2012
  - Schedule 3 – October 1, 2013
- State can allow up to 2 additional years

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5 Follow-Up Monitoring

- Subsequent source water monitoring
  - 6 years after initial bin classification (filtered systems)
  - 6 years after determination of mean *Crypto* levels (unfiltered systems)
  - Same requirements apply
- Can lead to bin reclassification

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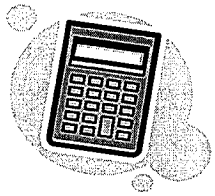
Profiling and Benchmarking

- Balance risks between microbial pathogens and DBPs
- Impact of Stage 2 DBPR and *Crypto* requirements
- Required when altering disinfection
  - Develop profile for *Giardia lamblia* and viruses
  - Calculate benchmark
- Requirements go into effect upon completion of initial monitoring



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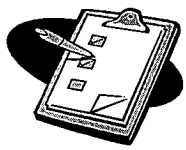
Other System Requirements

- Reporting and Public Notification
- Recordkeeping
- Uncovered finished water storage*
  - Cover or treat – Already covered by Texas Law



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Who do I call for early implementation help?

- Schedule 1, 2 & 3

  Mark McCasland

  EPA Region 6

  214.665.8088

  McCasland.Mark@epamail.epa.gov

- Schedule 4 - TCEQ

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Summary

- LT2ESWTR Goals
- Rule Overview
- Source Water Monitoring
- Bin & Treatment Overview
- Toolbox Options
- Implement Option(s)
- Follow-up Monitoring
- Profiling and Benchmarking
- Other Issues

Questions?

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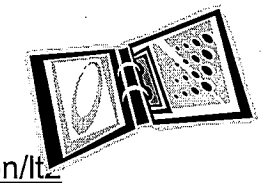
Resources



EPA Web Site
http://www.epa.gov/safewater/disinfection/lt2

- Federal Register Notice of the Final Rule
- Fact Sheets
- Quick Reference Guides
- Source Water Monitoring Guidance Manual
- Laboratory Guidance Manual
- List of Certified Labs for *Crypto*
- Point of Contact List
- Questions & Answers

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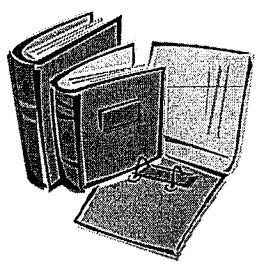
Additional Resources

- Drinking Water Academy
  - Free On-Line Training via Webcasts
  - Training Material Available for Download (Powerpoint presentations and/or Acrobat files)

http://www.epa.gov/safewater/dwa.html



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Acronyms and Definitions

Acronym	Definition
CCR	consumer confidence report
CFE	combined filter effluent
CFR	Code of Federal Regulations
Consecutive System	PWS that receives some or all of its finished water from a wholesale system(s)
Crypto	*Cryptosporidium*
CWS	community water system
DBPs	disinfection byproducts
DBPR	Disinfectants and Disinfection Byproducts Rule
GWUDI	ground water under the direct influence of surface water
ICR	Information Collection Rule

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Acronyms and Definitions (cont.)

Acronym	Definition
IFE	individual filter effluent
IESWTR	Interim Enhanced Surface Water Treatment Rule
log	logarithm (common, base 10)
LT1ESWTR	Long Term 1 Enhanced Surface Water Treatment Rule
MCL	Maximum contaminant level
M-DBP	Microbial-DBP suite of rules
M&R	monitoring and reporting
MRDL	maximum residual disinfectant level
mg/L	milligrams per Liter
NTU	nephelometric turbidity unit
PN	public notification

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Acronyms and Definitions (cont.)

Acronym	Definition
PWS	public water system
SDWA	Safe Drinking Water Act
Subpart H	surface water and GWUDI systems
SWTR	Surface Water Treatment Rule
TCR	Total Coliform Rule
Tier 1 Violation	violation requiring customer notification within 24 hours
Tier 2 Violation	violation requiring customer notification within 30 days
Tier 3 Violation	violation requiring customer notification within 12 months
TT	treatment technique
TTHM	total trihalomethanes, which is the sum of the trihalomethane compounds chloroform, bromoform, and dibromochloro- and bromodichloro-methane
Wholesale system	PWS that sells finished water to one or more consecutive systems

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Stage 2 Disinfection Byproducts Rule

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Outline

- History and Overview of Disinfection Byproducts (DBPs) and DBP Rules
  - Health effects
  - Conclusions forming basis for EPA rules
  - Simultaneous compliance
- DBP2 Regulatory Elements
  - Regulatory history
  - Early monitoring
  - Compliance calculation changes
  - DBP2 Best Available Technology

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Disinfection Byproducts

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Disinfection and Disinfection Byproducts

- Chlorine disinfection is recognized as one of the most important public health achievements of last century.
- Disinfection continues to be a primary public health risk barrier
- Chlorine and other disinfectants may have unfortunate byproducts
  - Potentially harmful – carcinogenic or reproductive concerns

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History: Detection

- 1970s
  - Communities with chlorinated water showed increased number of bladder cancer cases
- Hypothesis:
  - Chlorine reacts with naturally occurring organic matter to form potentially harmful disinfection byproducts
- Halogenated organic molecules were analyzed: Total Organic Halides (TOX)
  - Analytical methods were developed to find and identify specific species

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Chlorination DBPs

- **Cl_2 + TOC = DBPs**
  - Chlorine plus total organic carbon forms disinfection byproducts
- Main groups
  - Total trihalomethanes (TTHM)
    - Sum of four chlorinated / brominated species
  - Haloacetic acids (group of 5) (HAA5)
    - Sum of five chlorinated / brominated species
- Presence of THMs and HAAs indicates probable presence of other, unidentified, DBPs

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Identification of Chlorination DBPs

- Trihalomethanes
  - 30 to 70 percent of TOX
- Haloacetic Acids
  - 15 to 40 percent of TOX
- Total organic carbon (TOC)
  - Identified as surrogate for natural occurring organic precursors to DBP formation

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Chlorination DBPs Increase in Distribution System

- THMs and HAAs increase with:
  - Time in contact with chlorine or chloramine
  - Temperature
  - Concentration of chlorine or chloramine
- Customers farther from plant can be exposed to relatively higher levels

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Other disinfectant DBPs

- Ozone: $O_3 + Br^- = BrO_3$
  - Ozone plus naturally occurring bromide ion forms carcinogenic **bromate**
- Chlorine dioxide
  - Chlorine dioxide itself has adverse health effects, as does its direct byproduct, **chlorite**

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General Health Effects: Drinking Water Exposure

- Drinking:
  - Ingestion
    - Two liters per day, 70 years
- Bathing
  - Inhalation
    - THMs may volatilize in showers, baths
  - Dermal contact

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Disinfection Byproducts Rules and Health Effects

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History: Total Trihalomethane Rule (TTHMR)

- TTHMR *(adopted 11/21/1979)*:
  - Potential increased risk of bladder cancer from chlorinated water
  - Established MCL of 0.10 mg/L for TTHM
    - For Community (C) public water systems (PWSs) that serve 10,000 and apply disinfectant
    - Both surface and ground water
  - Based on running annual average of all samples collected in distribution system
    - Number of sample sites based on number of plants

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History: Stage 1 Disinfection Byproducts Rule (DBP1)

- DBP1 *(adopted 12/16/1998)*:
  - Additional research supported potential increased risk of bladder cancer with high THMs.
  - Research on potential acute reproductive effects was insufficient for locational or species regulation for THMs or HAAs
  - Additional disinfection byproducts health effects identified as sufficient for regulation: chlorite and bromate

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History: DBP1 (cont.)

- TTHM/HAA5 Requirements
  - Lowered MCL for TTHM, added MCL for HAA5
    - TTHM: 0.080 mg/L, HAA5: 0.060 mg/L
    - Still based on running annual average of all sites
    - Number of sites still based on number of plants
  - For community (C) and nontransient noncommunity (NTNC) PWSs
  - Extended to systems of all sizes with disinfectant
  - Required TOC removal for SWTPs

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History: DBP1 – DBPs from other disinfectants

- Added MCL for bromate
  - For all systems using ozone
  - Based on monthly samples at entry point
- Added MCL for chlorite
  - For all systems using chlorine dioxide
  - Based on daily entry point and monthly distribution monitoring

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History: DBP1 -- additional requirements

- Added MRDL for chlorine dioxide
  - (Maximum Residual Disinfectant Level)
  - 0.8 mg/L
  - For all systems that use chlorine dioxide
  - Based on daily and monthly EP and distribution
- MRDLs for chlorine and chloramine in distribution system
  - Based on weekly, daily and/or monthly samples
  - Based on running annual average of all samples

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Now! DBP2

- DPB2 *(adopted 1/4/2006)* Primary purpose:
  - Reduce peaks of THM and HAA in the distribution system while maintaining microbial protection
  - Provide more equitable health protection for all drinking water consumers

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DBP2 Health Effects Studies

- Additional research available for DBP2:
  - Cancer endpoints:
    - 24 epidemiological or animal studies,
    - 17 positive, 7 inconclusive
  - Reproductive endpoints:
    - 40 epidemiological or animal studies
    - Various results

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Cancer End Points

- Research examined various cancer end points:
  - Bladder: Potential increased risk
  - Rectal, renal: Possible association
  - Kidney, brain, lung: Possible association
  - Leukemia: Little or no association
  - Pancreatic: No association
  - All cancers grouped together: Associated

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Cancer End Points: Basis for regulation

- "New cancer data since Stage 1 strengthen the evidence of a potential association between bladder cancer and chlorinated water and suggests an association for colon and rectal cancers."
  - *-- Preamble to DBP2*

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Reproductive End Points

- Research examined various reproductive end points:
  - Small babies
    - Low birth weight, Lower than term weight, intrauterine growth retardation
  - Pre-term delivery
  - Birth defects
    - Heart defects, Neural tube defects, Oral clefts
  - Miscarriage
  - Stillbirth

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Reproductive End Points: Basis for regulation

- "Current reproductive and developmental health effects do not support a conclusion at this time as to whether exposure to chlorinated drinking water or disinfection byproducts causes adverse developmental or reproductive health effects, but do support a potential health concern"
  - *-- preamble to DBP2*

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Overall Health Effects: Basis for regulation

- "The combined health data indicate a need for public health protection beyond that provided by the Stage 1 DBPR."
  - *-- preamble to DBP2*

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Conceptual Elements to Curtail THM/HAA Peaks

- Wholesale and consecutive systems
  - Additional definitions intended to ensure all customers are equitably protected
- Combined distribution system
  - Ensure interconnected systems coordinate
- Population based monitoring
  - To replace plant-based monitoring, because rule is implemented in distribution system not plant
- Locational running annual averages
  - New compliance determination to address 'hot spots'

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Best Available Technology for DBP2

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Best Available Technology (BAT)

- EPA is required to identify control strategies and evaluate potential costs
  - As a function of system size
  - As a function of water source
    - PWS-owned and treated
      - Treatment technologies
    - Purchased, disinfected water
      - Removal or control strategies
  - To support cost analysis of rule
    - And ensure that mitigation technology exists

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BATs

- Systems treating surface water
  - GAC10:
  - GAC20:
- Systems distributing purchased potable water
  - Chloramination
  - Operation of distribution system to minimize formation

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Costs and Benefits of DBP2

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Economic analysis looked at a range of alternatives

Alternative	THM / HAA		Bromate MCL
	Compliance method	MCLs	
Preferred Alternative	LRAA	0.080 / 0.060 mg/L	0.010 mg/L
Alternative 1	LRAA	0.080 / 0.060 mg/L	0.005 mg/L
Alternative 2	Every Sample	0.080 / 0.060 mg/L	0.010 mg/L
Alternative 3	System-wide RAA	0.040 / 0.030 mg/L	0.010 mg/L

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Benefits of DBP2

- Benefit analysis based on number of bladder cancer cases avoided by TTHM reduction
  - About 506 – 546 cases avoided
    - (37 – 1,523 range)
  - 26% fatal, 74% non-fatal

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Benefits of DBP2, cont.

- Monetization of benefit
  - Value of statistical life (VSL)
    - $5.6 million (elsewhere $6.3 million)
  - Willingness to pay (to avoid non-fatal case)
    - Cost of illness measurement ($121,000) or
    - Willingness to pay measurement ($587,500)

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Costs of DBP2

- Costs to PWSs needing to change treatment
  - Estimated number of plants
  - Estimated number of system
- Costs of reporting to all PWSs
- Costs to state governments

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Costs of DBP2

- 95% of households will incur $0-12/yr.
- 4% of households will incur $12-40/yr.
- 1% of households will incur $120-400/yr

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Economic Analysis: Cost and Benefit of Alternatives

Alternative	Annual Costs	Annual Benefits
Preferred Alternative	$ 79	$ 1,531
Alternative 1	$ 254	$ 1,377
Alternative 2	$ 422	$ 5,187
Alternative 3	$ 634	$ 7,130

* One example of cost/benefit

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Elements of DBP2

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Intent of DBP2

- Reduce the exposure of customers in areas of the distribution system with relatively high disinfection byproducts.
  - Cut down on peaks in the distribution system
- Regulatory Strategy
  - Find hot spots through Initial Distribution System Evaluation (IDSE)
  - Base compliance on locational running annual average (LRAA) at hot spots
  - Require operational evaluation of distribution system for smaller peaks at hot spots
  - Define technology capable of obtaining compliance in a cost effective way

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Elements of DBP2

- Scheduling based on combined distribution system (CDS)
- Early monitoring (IDSE)
  - To determine distribution water quality
- Select new compliance sites
  - Based on IDSE
  - (Or consultation with TCEQ)
- New way to calculate compliance
  - Locational Running Annual Average
  - Same old MCL applies at each (new) site

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Concept of Combined Distribution System (CDS)

- CDS Concept:
  - If one system has to make changes…
    - eg: Switch to chloramines
  - And it is connected to other systems…
  - The connected systems will ALSO need to make changes …
    - eg: Switch to chloramines
  - So EPA applies the same regulatory schedules to the entire CDS group

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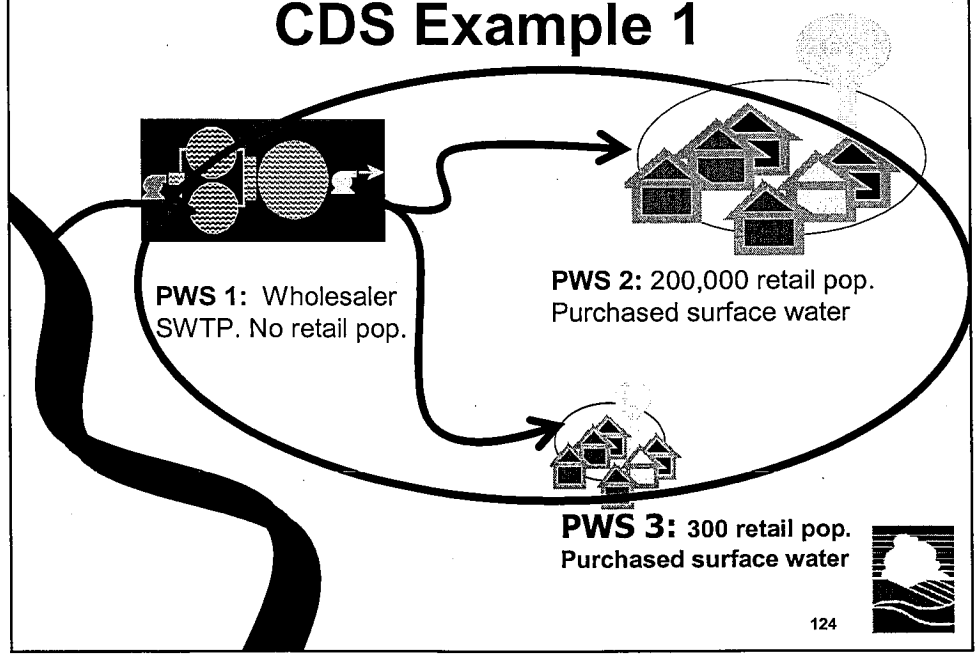
CDS Example 1



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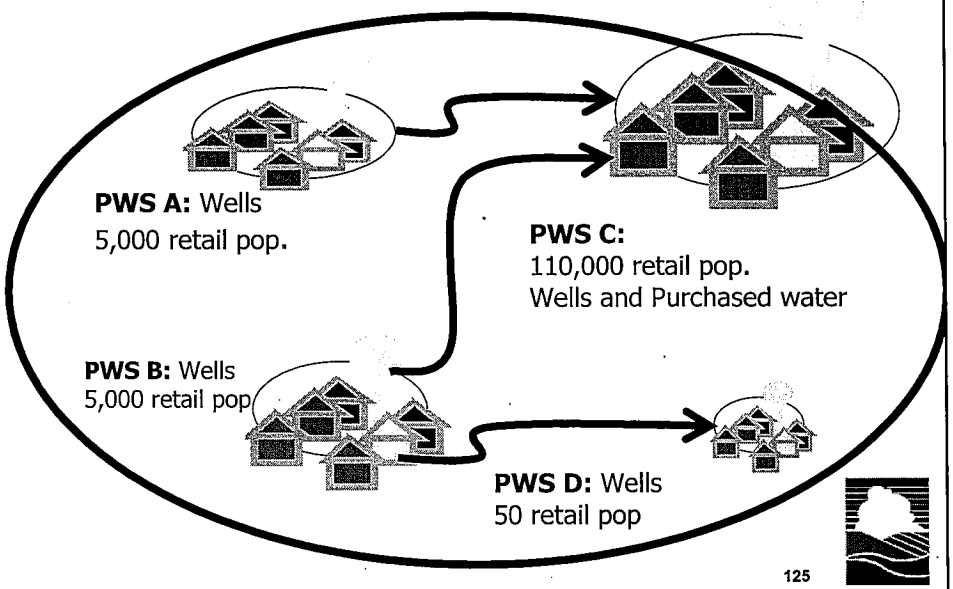
CDS Example 2



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Schedules are based on the Group number for DBP2

Group Number	Population: Based on size of largest system in Combined Distribution System *
Group 1	100,000 or more
Group 2	50,000 – 99,999
Group 3	10,000 – 49,999
Group 4	Less than 10,000

Notes: LT2 only applies to PWSs that treat surface water.
DBP2 applies to systems that have a disinfectant residual.

126

Purpose of IDSE

- Initial Distribution System Evaluation
  - Designed to find 'worst case' areas for disinfection byproducts in distribution system
    - 'hot spots'
  - Pick new DBP2 sample sites in worst case areas
    - Number of sites based on population and water type, not number of plants

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IDSE Timing by Population

(of combined distribution system *)

Population Group *	IDSE Plan ** due by …	Finish IDSE sampling *** by…	IDSE Report **** due by…
Group 1	**10/1/06**	**9/30/08**	**1/1/09**
Group 2	**4/1/07**	**3/31/09**	**7/1/09**
Group 3	**10/1/07**	**9/30/09**	**1/1/10**
Group 4	**4/1/08**	**3/31/10**	**7/1/10**

*Group based on population of largest system in combined distribution system.
** Or System Specific Study Plan,
*** Or System Specific sampling
**** Or System Specific Study Report or waiver due.

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There are four ways to comply with the IDSE...

- Very Small System (VSS) Waiver
- Low Level (40/30) Waiver
- Do standard IDSE sampling
- System specific study
  - Plan must be approved by TCEQ
  - Specific hydraulic study of system
  - Grandfathered DBP sampling

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Very Small System Waivers

- Systems with population less than 500
  - INCLUDES True Wholesalers
  - Based on most recent survey
  - System must have DBP1 results
    - All Texas systems were scheduled
  - Sample site at Maximum Water Age
- All systems should have samples
  - But some have delinquent accounts

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40/30 Waiver

- Eligibility for 40/30 waiver:
  - All TTHM results must be less than 0.040 mg/L (40 micrograms per liter, ug/L)
  - All HAA5 results must be less than 0.030 mg/L (30 ug/L)
- Every single sample
  - Of samples collected for DBP1 compliance

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Timing for samples <40/30 for 40/30 waiver

System schedule	All samples have to be less than 40/30 for eight consecutive quarters *
Group 1	Calendar years 2004 thru 2005
Group 2	(beginning no earlier than January 2004)
Group 3	Calendar years 2005 thru 2006
Group 4	(beginning no earlier than January 2005)

* For a system on triennial sampling, this may be a single sample event, For a system on annual, it can be two.

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System Specific Study

- Hydraulic model
  - 75% of pipe volume
  - 50% of pipe length
  - All pressure zones
  - All 12-inch diameter and larger pipes
  - All 8-inch and larger pipes that are significant
  - All 6-inch and larger pipes that go to remote areas
  - All storage facilities
  - All active pump stations
  - All active control valves
  - Be calibrated

133

System Specific Study

- Special sampling
  - About two times as many samples as under IDSE Standard Sampling
  - Sample plan must be approved by state

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Systems that don't get waiver or SSS must do IDSE sampling

- Standard IDSE Sampling
  - Initial distribution system evaluation
  - To determine worst case Stage 2 DBP sites
- Schedule based on CDS
  - But number of sites and frequency based on individual system
    - Population served and type of water

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IDSE sites: Surface Water

Population	# of Sites	Types of sites				Schedule
		Near EP	Ave RT	High THM	High HAA	
Less than 500 *	2			1*	1*	4 / yr
500 to 3,300 **	2	-	-	1	1	
3,301 to 9,999 **	4	-	1	2	1	
10,000 to 49,999	8	1	2	3	2	6 / yr
50,000 to 249,999	16	3	4	5	4	
250,000 to 999,999	24	4	6	8	6	
1,000,000 to 4,999,999	32	6	8	10	8	
> 5,000,000	40	8	10	12	10	

* If high HAA and THM are at same site, only need one site
** Systems that purchase water can replace the High HAA site with a Take Point

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IDSE sites: Ground Water

Population	# of Sites	Types of sites				Schedule
		Near EP	Ave RT	High THM	High HAA	
< 500 *	2	-	-	1	1	1 / yr Summer
500 to 9,999	2	-	-	1	1	4 / yr
10,000 to 99,999	6	1	1	2	2	
100,000 to 499,999	8	1	1	3	3	
> 500,000	12	2	2	4	4	

* Systems that purchase water can replace the High HAA site with a Take Point

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IDSE results are not used for compliance

- During early implementation period
  - Current DBP1 sample site results will be used for compliance
  - New IDSE sample site results will not be used for compliance
  - TCEQ will approve and track each specific IDSE and DBP1 compliance sample site
    - PWS will need to submit written request, with justification, to alter sample site

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IDSE Sample Report lists results and sets DBP2 sites

- All THM/HAA sample results listed by site
- Explanation of any changes from IDSE Sample Plan
  - With schematic showing changes
- Recommendation for DBP2 sites
  - And justification for selections

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DBP2 sites: Surface Water

Population	# of Sites	Types of sites			Schedule
		High THM	High HAA	DBP1	
< 500	2	1	1	-	Annual
500 to 3,300	2	1	1	-	Quarterly
3,301 to 9,999	2	1	1	-	
10,000 to 49,999	4	2	1	1	
50,000 to 249,999	8	3	3	2	
250,000 to 999,999	12	3	4	3	
1,000,000 to 4,999,999	16	6	6	4	
> 5,000,000	20	8	7	5	

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DBP2 sites: Ground Water

Population	# of Sites	Types of sites			Schedule
		High THM	High HAA	DBP1	
< 500	2	1	1	-	Annual
500 to 9,999	2	1	1	-	
10,000 to 99,999	4	2	1	1	Quarterly
100,000 to 499,999	6	3	2	1	
> 500,000	8	3	3	2	

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Review of DBP2 Sites

- Some system will not have to do IDSE to set DBP2 sites
  - Because of VSS or 40/30 waiver
  - They will still need to pick new sites
  - Following same protocols by which IDSE sites were selected
  - Submit proposed sites to state for approval

142

Locational Running Annual Average (LRAA) Compliance

- New calculation method
  - NOT new MCL
  - Running annual average at each location (LRAA)
  - Exceedance at one site causes system to violate MCL

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Operational Evaluation Level (OEL) Compliance

- If PWS exceeds OEL at any site, that system must evaluate distribution operations
- OEL (THM / HAA)
  - Two times current quarter results, plus results of previous two quarters, divided by four
  - Exceed 80/60 (micrograms per liter THM/HAA)

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Operational Evaluation (OE) Performance

- Operational Evaluation (OE) must include report describing all pertinent
  - Treatment
    - Description of operational practices, and
    - Any changes or problems
  - Distribution operational practices, including
    - Storage tank operations,
    - Excess storage capacity,
    - Distribution system flushing,
  - Changes in sources or source water quality,
  - Plan to minimize future exceedances
- May request to limit the scope of evaluation if able to identify the cause of the OEL exceedance

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LRAA and OEL Compliance Timing

Population Group *	Compliance calculated using LRAA starting…
Group 1	April 1, 2012
Group 2	October 1, 2012
Group 3	October 1, 2013
Group 4	

* Group based on population of largest system in combined distribution system.

146

Acronyms

- DBP: disinfection byproducts
- DBP1: Stage **1** DBP Rule (adopted 12/16/98)
- DBP2: Stage **2** DBP Rule (adopted 1/5/06)
- THM: **trih**alo**m**ethane
- HAA: **h**aloa**a**cetic acid
- IDSE: Initial Distribution System Evaluation
- RAA: running annual average
- LRAA: locational running annual average
- CDS: combined distribution system
- MCL: maximum contaminant level

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Public Notice Rule & Consumer Confidence Report

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Public Notice Rule

- TCEQ must adopt requirements that were part of Public Notice Rule
  - 24-hour notice
    - Replaces notification by "end of next business day"
  - Certificate of Delivery

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Consumer Confidence Report

- DBP2
  - "The system is required to include individual sample results for the IDSE … when determining the range of TTHM and HAA5 results to be reported in the annual CCR for the calendar year that the IDSE samples were taken"

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Consumer Confidence Report

- LT2
  - If the system has performed any monitoring for *Cryptosporidium,* including monitoring performed to satisfy the requirements of 40 CFR §141.143, which indicates that *Cryptosporidium* may be present in the source water or the finished water, the report must include:
    - (i) A summary of the results of the monitoring; and
    - (ii) An explanation of the significance of the results.

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Thanks!

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